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Mixture parameters of a trivariate normal superposition from sample cumulants: Application to the local stellar velocity distribution

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ABSTRACT

The velocity distribution of nearby stars can be studied as a mixture of two main population components. In order to determine the mixing proportions and the population parameters a combined geometric-statistical method has been developed. The overall distribution is approximated from a superposition of two trivariate normal velocity density functions. The peculiar velocity is projected on a plane containing the global centroid (mean of the distribution), which is ortogonal to the direction D through both population subcentroids, obtaining two linear independent projected velocities. The statistical moments of these new variables are computed from second, third and fourth-order sample cumulants. The symmetric behaviour of the distribution around the direction D allows to determine it working only from third cumulants. Finally the overall set of projected peculiar velocity moments is used to determine the population covariance matrices, population means, and mixture proportions. The method does not require any extra hypotheses such as those concerning to prior population parameters, or specific symmetries of the distribution.

Keywords: *finite mixture distributions, normal mixture distributions, distribution and sample moments and cumulants, stellar kinematics, stellar populations.*

Mathematics Subject Classification: *60, 62, 85*

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